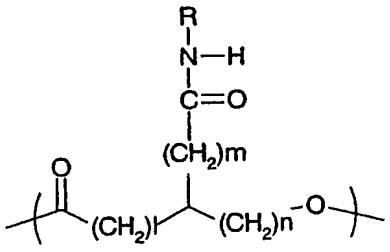
CLAIMS

1. A polyhydroxyalkanoate characterized in that the polyhydroxyalkanoate comprises one or more units represented by the chemical formula (1) in a molecule:

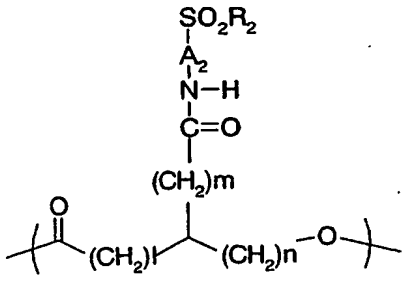


(1)

wherein R represents $-A_1-SO_2R_1$; R_1 is selected from the group consisting of OH, a halogen atom, ONa, OK and OR_{1a}; R_{1a} and A_1 independently represent a group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure or a substituted or unsubstituted heterocyclic structure, respectively; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present, R, R_1, R_{1a}, A_1, l, m and n mean as above independently for every unit.

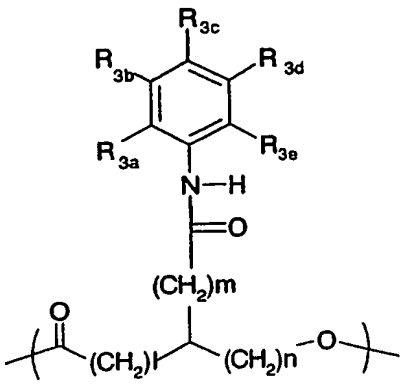
2. The polyhydroxyalkanoate according to claim 1 characterized in that the polyhydroxyalkanoate comprises one or more units selected from those

represented by the chemical formula (2), the chemical formula (3), the chemical formula (4A) or the chemical formula (4B) in a molecule as a unit of chemical formula (1)



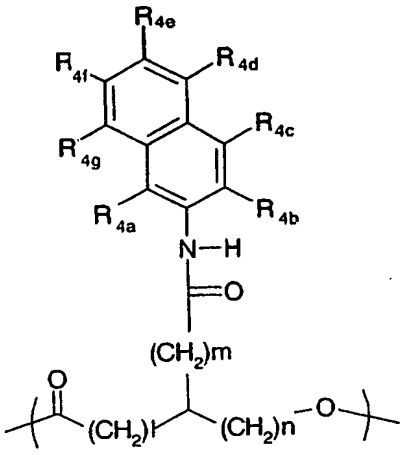
(2)

wherein R_2 is selected from the group consisting of OH, a halogen atom, ONa, OK and OR_{2a}; R_{2a} is a linear or branched alkyl group having 1 to 8 carbon atoms or a substituted or unsubstituted phenyl group; A_2 represents a linear or branched alkylene group having 1 to 8 carbon atoms; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4 and m is an integer selected from 0 to 8; and when two or more units are present, A_2, R_2, R_{2a}, l, m and n mean as above independently for every unit.



(3)

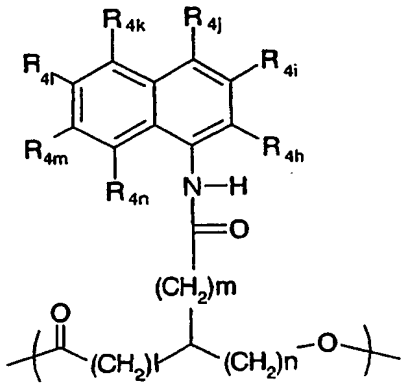
wherein R_{3a}, R_{3b}, R_{3c}, R_{3d} and R_{3e} are independently SO_2R_{3f} wherein R_{3f} is selected from the group consisting of OH, a halogen atom, ONa, OK and OR_{3f1}, wherein OR_{3f1} is a linear or branched alkyl group having 1 to 8 carbon atoms or a substituted or unsubstituted phenyl group; a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms, OH group, NH_2 group, NO_2 group, $COOR_{3g}$ group, wherein R_{3g} represents any of H atom, Na atom and K atom; an acetamide group, OPh group, NHPh group, CF_3 group, C_2F_5 group or C_3F_7 group, wherein Ph represents a phenyl group, respectively, and at least one of these groups is SO_2R_{3f}; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present, R_{3a}, R_{3b}, R_{3c}, R_{3d}, R_{3e}, R_{3f}, R_{3f1}, R_{3g}, and l, m and n mean as above independently for every unit



(4A)

wherein R_{4a}, R_{4b}, R_{4c}, R_{4d}, R_{4e}, R_{4f} and R_{4g} are independently SO_2R_{4o}, wherein R_{4o} is selected from the group consisting of OH, a halogen atom, ONa, OK and OR_{4o1}, wherein OR_{4o1} is a linear or branched alkyl group having 1 to 8 carbon atoms or a substituted or unsubstituted phenyl group; a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms, OH group, NH_2 group, NO_2 group, $COOR_{4p}$ group, wherein R_{4p} represents any of H atom, Na atom and K atom; an acetamide group, OPh group, NHPh group, CF_3 group, C_2F_5 group or C_3F_7 group, wherein Ph represents a phenyl group, respectively, and at least one of these groups is SO_2R_{4o}; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present, R_{4a}, R_{4b}, R_{4c}, R_{4d}, R_{4e}, R_{4f}, R_{4g}, R_{4o},

R_{4o1}, R_{4p}, and l, m and n mean as above independently for every unit

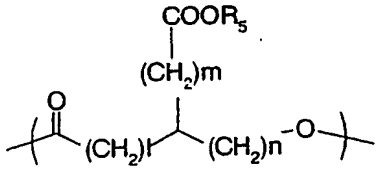


(4 B)

wherein R_{4h}, R_{4i}, R_{4j}, R_{4k}, R_{4l}, R_{4m} and R_{4n} are independently SO_2R_{4o}, wherein R_{4o} is selected from the group consisting of OH, a halogen atom, ONa, OK and OR_{4o1}, wherein OR_{4o1} is a linear or branched alkyl group having 1 to 8 carbon atoms or a substituted or unsubstituted phenyl group; a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms, OH group, NH_2 group, NO_2 group, $COOR_{4p}$ group, wherein R_{4p} represents any of H atom, Na atom and K atom; an acetamide group, OPh group, NHPh group, CF_3 group, C_2F_5 group or C_3F_7 group, wherein Ph represents a phenyl group, respectively, and at least one of these groups is SO_2R_{4o}; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more

units are present, R_{4h}, R_{4i}, R_{4j}, R_{4k}, R_{4l}, R_{4m}, R_{4n}, R_{4o}, R_{4ol}, R_{4p}, and l, m and n mean as above independently for every unit.

3. A polyhydroxyalkanoate characterized in that the polyhydroxyalkanoate comprises one or more units represented by the chemical formula (5) in a molecule:

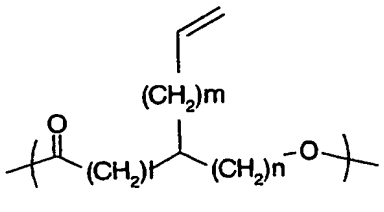


(5)

wherein R_5 is hydrogen, a salt forming group or R_{5a}; R_{5a} is a linear or branched alkyl group having 1 to 12 carbon atoms, an aralkyl group or a substituent having a saccharide; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, m is an integer selected from 0 to 8; and when l is 1, 3 and 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when l is 2 and n is 1, 3 and 4, m is an integer selected from 0 to 8; and when l is 2 and n is 2, m is an integer selected from 1 to 8; and when l is 2, n is 2 and m is 0, R_{5a} is a substituent having a saccharide; and when two or more units are present, R_5, R_{5a}, and l, m and n mean as above independently for every unit.

4. A polyhydroxyalkanoate characterized in that

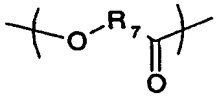
the polyhydroxyalkanoate comprises one or more units represented by the chemical formula (6) in a molecule:



(6)

wherein l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present, l, m, and n mean as above independently for every unit.

5. The polyhydroxyalkanoate according to any one of claims 1 to 4 characterized in that the polyhydroxyalkanoate further comprises one or more units represented by the chemical formula (7) in a molecule:

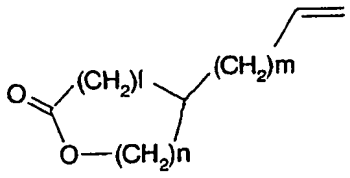


(7)

wherein R_7 is a linear or branched alkylene group having 1 to 11 carbon atoms, an alkyleneoxyalkylene group, wherein each alkylene group is independently an alkylene group having 1 to 2 carbon atoms, respectively or an alkylidene group having 1 to 5

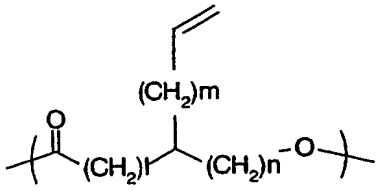
carbon atoms which may be substituted with aryl; and when two or more units are present, R_7 means as above independently for every unit.

6. A production method of polyhydroxyalkanoate represented by the chemical formula (6) characterized in that the method comprises a step of polymerizing a compound represented by the chemical formula (8) in the presence of a catalyst



(8)

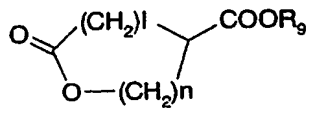
wherein l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8



(6)

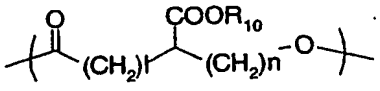
wherein l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present, l, m and n mean as above independently for every unit.

7. A production method of polyhydroxyalkanoate represented by the chemical formula (10) characterized in that the method comprises a step of polymerizing a compound represented by the chemical formula (9) in the presence of a catalyst



(9)

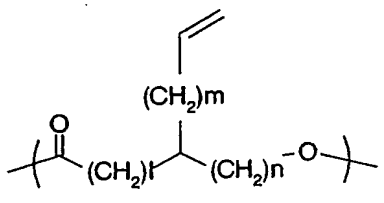
wherein R_9 is a substituent selected from a linear or branched alkyl group having 1 to 12 carbon atoms or an aralkyl group; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and when l is 1, 3 or 4, n is an integer selected from 1 to 4, and when l is 2, n is 1, 3 or 4



(10)

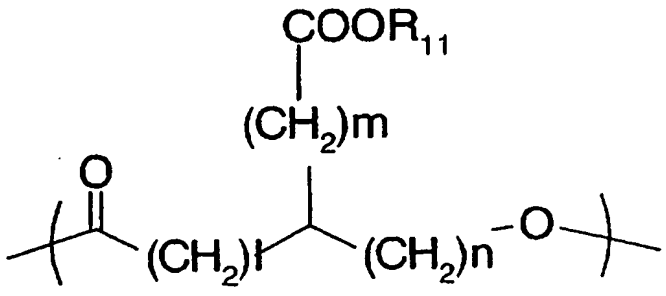
wherein R_{10} is a linear or branched alkyl group having 1 to 12 carbon atoms or an aralkyl group; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and when l is 1, 3 or 4, n is an integer selected from 1 to 4, and when l is 2, n is 1, 3 or 4; and when two or more units are present, l, n and R_{10} mean as above independently for every unit.

8. A production method of polyhydroxyalkanoate containing a unit represented by the chemical formula (11) characterized in that the method comprises a step of oxidizing a double bond portion of polyhydroxyalkanoate containing a unit represented by the chemical formula (6):



(6)

wherein l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present, l, m and n mean as above independently for every unit

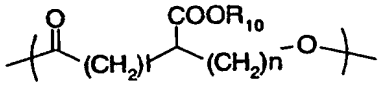


(11)

wherein R_{11} is hydrogen or a salt forming group; l is an integer selected from 1 to 4, n is an integer

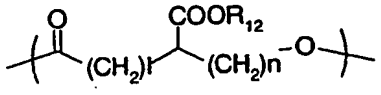
selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present, l, m, n and R_{11} mean as above independently for every unit.

9. A production method of polyhydroxyalkanoate containing a unit represented by the chemical formula (12) characterized in that the method comprises a step of hydrolyzing a polyhydroxyalkanoate containing a unit represented by the chemical formula (10) in the presence of acid or alkali, or subjecting a polyhydroxyalkanoate containing a unit represented by the chemical formula (10) to hydrocracking including catalytic reduction:



(10)

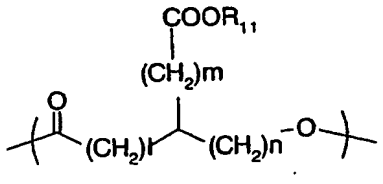
wherein R_{10} is a substituent selected from a linear or branched alkyl group having 1 to 12 carbon atoms or an aralkyl group; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and when l is 1, 3 or 4, n is an integer selected from 1 to 4, and when l is 2, n is 1, 3 or 4; and when two or more units are present, l, n and R_{10} mean as above independently for every unit



(12)

wherein R_{12} is hydrogen or a salt forming group; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and when l is 1, 3, and 4, n is an integer selected from 1 to 4, and when l is 2, n is 1, 3, and 4; and when two or more units are present, l, n and R_{12} mean as above independently for every unit.

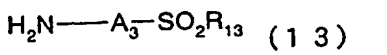
10. A production method of polyhydroxyalkanoate containing a unit represented by the chemical formula (1) characterized in that the method comprises a step of subjecting a polyhydroxyalkanoate containing a unit represented by the chemical formula (11) and at least one amine compound represented by the chemical formula (13) to condensation reaction:



(11)

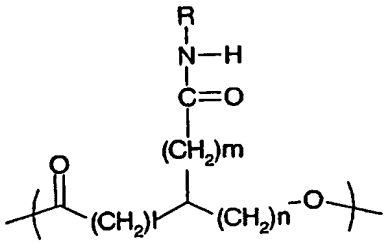
wherein R_{11} is hydrogen or a salt forming group; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present,

l, m, n and R_{11} mean as above independently for every unit



(13)

wherein R_{13} is selected from the group consisting of OH, a halogen atom, ONa, OK and OR_{13a}; R_{13a} and A_3 are independently selected from a group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure or a substituted or unsubstituted heterocyclic structure, respectively; and when two or more units are present, R_{13}, R_{13a} and A_3 mean as above independently for every unit



(1)

wherein R represents $-A_1-SO_2R_1$; R_1 is selected from the group consisting of OH, a halogen atom, ONa, OK and OR_{1a}; R_{1a} and A_1 independently represent a group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure or a substituted or

unsubstituted heterocyclic structure, respectively; l is an integer selected from 1 to 4, n is an integer selected from 1 to 4, and m is an integer selected from 0 to 8; and when two or more units are present, R, R_1, R_{1a}, A_1, and l, m and n mean as above independently for every unit.